

**DIVERSITY OF THE LEAFHOPPER (HOMOPTERA: CICADELLIDAE)
FAUNA OF NORTHERN CHIHUAHUAN GRASSLANDS, WITH EMPHASIS
ON GYPSUM GRASSLANDS AND DESCRIPTION OF A NEW SPECIES OF
ATHYSANELLA (CICADELLIDAE: DELTOCEPHALINAE)**

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Abstract.—Extensive areas of the northern Chihuahuan Desert of southeastern New Mexico and adjacent Texas have gypsum (gyp) outcroppings. The plant communities of these regions contain a mixture of gypsum-tolerant plants characteristic of the semiarid grasslands surrounding the gyp islands, and plants endemic to or characteristic of and attaining highest abundance in gyp areas. The insularity of the gyp formations provides an ideal situation for insect as well as plant evolution. Collections were made on 37 dominant or subdominant perennial grasses of the region. Twelve generalists and 54 specialist leafhopper species were recorded. The leafhopper diversity of the grasslands is explained by the existence of a large number of perennial grass hosts. Two of the hosts, gyp grama (*Bouteloua breviseta*) and gyp dropseed (*Sporobolus nealleyi*) account for three of the specialists, which are therefore endemic to gyp grasslands. One of these specialists is *Athysanella* (*Athysanella*) *blockeri*, n. sp., taken from gyp grama, *Bouteloua breviseta*, and is described herein. Other leafhopper-grass host relationships in the New Mexico–Texas grasslands studied, on both gyp and nongyp soils, were similar to those of adjacent vegetational regions.

Key Words: Leafhopper, grassland, gypsum, ecology

Gypsum deposits, which occur in many regions of the southwestern United States and northern Mexico (Johnson 1941), are presumed to be evidence of ancient marine deposits, thought by some to date to the Permian. The exposure of these deposits may date to the mid-Tertiary, or may in some cases may be as recent as the Pleistocene (Powell and Turner 1977).

The soils of gypsum (gyp) “islands” are a powerful insularizing factor. A number of endemic plant species have arisen as gypsophiles, and indeed, some genera (e.g. *Neristyrénia*) appear to be largely gypsophilous. There is evidence for speciation of gypsophilous plants after colonization of individual gyp islands.

Knowledge of the botany of the gyp islands of trans-Pecos Texas and New Mexico (Waterfall 1946) is limited; even less is known about their insect fauna. In this paper, we describe the leafhopper (cicadellid) fauna of dominant and subdominant perennial grasses of gyp and nongyp areas of the northern Chihuahuan grasslands of southeastern New Mexico and adjacent Texas, and describe a new species of the genus *Athysanella* that is apparently endemic to gyp grasslands of this region.

METHODS

Methods for collection and identification of leafhopper specimens have been de-

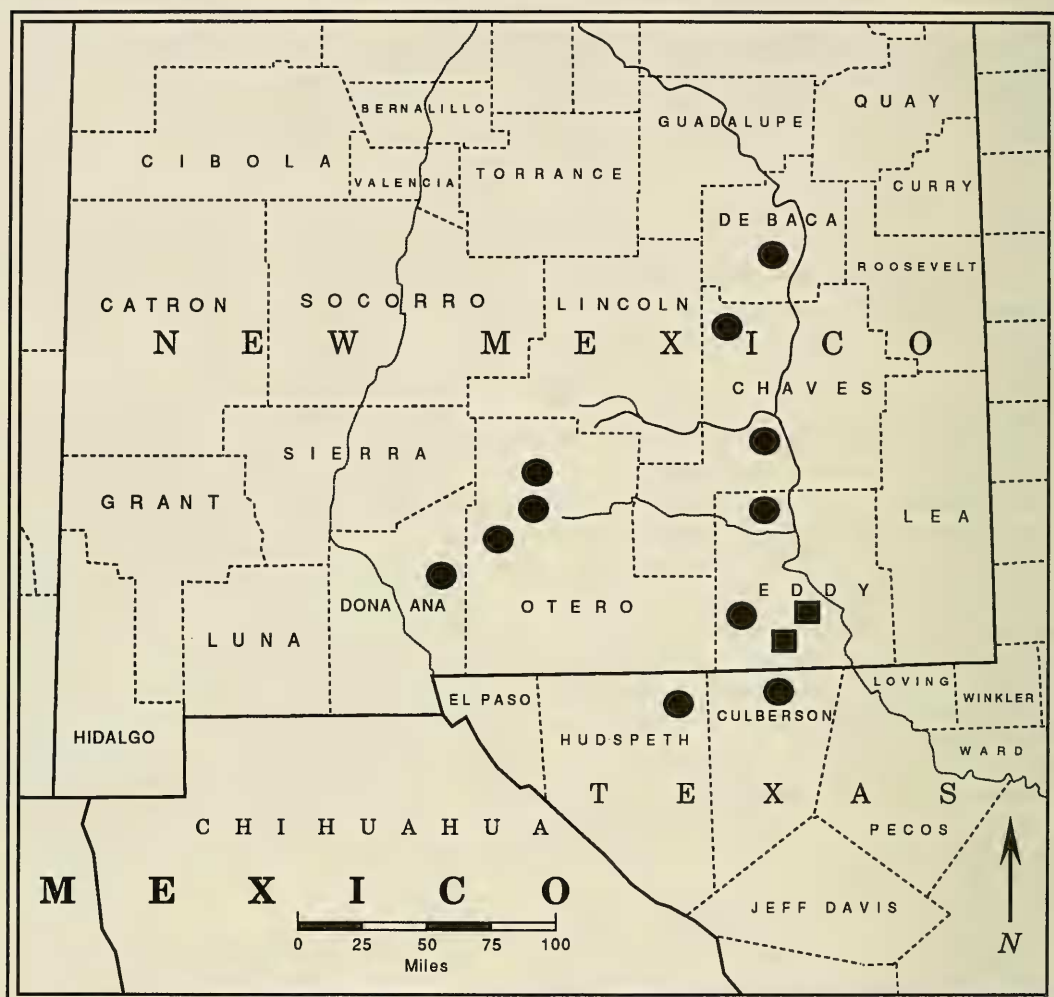


Fig. 1. Localities for collections summarized in this paper. Collections were from low elevation grasslands (3800–5400 ft). Material from higher elevations of the Sacramento and Guadalupe Mountains was not included.

scribed (Whitcomb et al. 1986, 1987). Localities (Fig. 1) of the collections described herein are drawn from a large matrix of data (Lynn and Whitcomb 1987) compiled over many years for host records of leafhoppers from North American grasslands. IBL (Insect Biocontrol Laboratory, Beltsville, Maryland) accession numbers selected for analysis in this paper are 0840–845; 0854–875; 1919–1925; 1928–1991; 2099–2115; 2176–81; 2184–85; 2193; 2196–97; 3514–3518; 3543–3558; and 3571–3580. Plant specimens were taken as vouchers for many collections. Binomial names of grass spe-

cies studied are given in Appendix 1. Insect specimens, with the exception of holotypes and some paratypes, and notes on each accession, are stored in the IBL collection.

RESULTS

Our surveys of gyp grasslands in southeastern New Mexico and adjacent Texas are summarized in Table 1. A total of 37 dominant or subdominant grass species (Appendix 1) were studied. Leafhoppers collected on these grasses could be classified as either generalists or specialists. Although the classification of each leafhopper species was

derived from these surveys, it was also consistent with previously reported surveys (Whitcomb et al. 1986, 1987, 1988) of Chihuahuan grasslands of trans-Pecos Texas such as those of the Davis Mountains, Guadalupe National Park, and Big Bend National Park.

Twelve generalist leafhopper species were collected regularly on many grass species (Table 1). These generalists were found on annual and/or exotic grasses as well as native perennials. In contrast, 54 leafhopper species were classified as specialists. The degree of specialization of these species was quantified by computing the oligophagy coefficients (Whitcomb et al. 1987, 1988) for these species, using the southeastern New Mexico-Texas data set. Seven cicadellid species occurred so infrequently that their status could not be inferred.

Three host specialists were found on gyp endemic plant species. *Athysanella blockeri* Hicks & Whitcomb is a new species and is described below. The other two gyp endemic specialists, *A. (Athysanella) stylosa* Blocker & Johnson and *A. (Athysanella) pastora* Blocker and Johnson collected in some accessions summarized here, were previously described (Blocker and Johnson 1988a). *Athysanella (Amphipyga) ladella* Johnson was found on several grass species, and may be a habitat specialist. In addition, some species adapted to grasses such as alkali sacaton (*Sporobolus airoides*) and saltgrass (*Distichlis stricta*) were common in gyp communities. Host relationships in the region were similar or identical to those of adjacent regions (Whitcomb et al. 1987, 1988), so the leafhopper composition of gyp areas could be explained entirely, or almost so, by the species composition of the gyp plant communities.

DISCUSSION

The New Mexico and Texas grasslands studied represent essentially the northernmost extent of the Chihuahuan Desert. Almost all grass-inhabiting leafhoppers of this region could be classified readily as gen-

eralists or specialists. The classification, which was derived from the data for this region alone, was reinforced by our data base on host relationships in North American grasslands from Canada to Mexico (Whitcomb et al. 1986, 1987, 1988, 1990, Whitcomb and Hicks 1994, Hicks et al. 1988, 1990, Blocker et al. 1990). Although all leafhopper species studied (Table 1) are believed to reside largely or entirely on grasses, our records indicate that some of the species may feed on forbs in the fall or early spring when their grass hosts are unavailable. Our data document adult food hosts, but in many cases regular collection of immatures from host plants confirmed specific host plant associations.

A number of leafhopper species are associated principally or entirely with forbs. These include members of the genera *Norvellina*, *Texananus*, *Driotura*, *Paraphlepsius*, *Acinopterus*, *Scaphytopius*, and several genera of the Gyponinae. Although occasional specimens of these species were encountered in our surveys, we know little of their biologies. In cases where life histories of certain species of these genera have been studied, their biologies have turned out to be complex. For the biology of these species to be fully understood, each species may have to be studied idiosyncratically, on its own terms.

Most or all of the rules governing assembly of insect-grassland communities in northern Chihuahuan grasslands follow directly from those outlined in our series of publications on grass-leafhopper relationships (Whitcomb et al. 1986, 1987, 1988). Among the most important factors in the biogeographical relationships is the historical (phylogenetic) component. For example, many species of the genus *Athysanella*, especially its typical subgenus, have evolved extensively with lowland gyp/alkaline/saline habitats. This genus is therefore one of the principal component taxa enhancing diversity in northern Chihuahuan grasslands. In recent papers, we have discussed the role of phenology (Hicks et al.

Table 1. Association of cicadellid species and dominant or subdominant grasses of southeastern New Mexico lowlands.

Grass species	Generalists ¹						
	n ²	Au	Asp	Bg	Bn	Ct	Dsp
<i>Aristida</i> spp.	2	3	2	0	31	0	0
<i>Bothriochloa</i> spp.	1	0	16	0	18	0	0
<i>Bouteloua breviseta</i>	10	23	7	0	77	0	0
<i>B. curtipendula</i>	4	0	1	0	9	0	0
<i>B. eriopoda</i>	3	1	3	0	1	0	0
<i>B. gracilis</i>	11	0	3	0	120	0	0
<i>B. hirsuta</i>	2	0	0	0	1	0	0
<i>Buchloë dactyloides</i>	11	8	1	0	13	0	0
<i>Chloris cucullata</i>	2	16	1	2	38	0	0
<i>C. verticillata</i>	1	1	0	0	4	0	0
<i>Cynodon dactylon</i>	1	1	0	0	15	0	0
<i>Distichlis stricta</i>	6	0	0	0	3	0	0
<i>Erioneuron pilosum</i>	2	3	1	0	8	0	0
<i>E. pulchellum</i>	2	4	4	0	1	0	0
<i>Hilaria mutica</i>	6	0	1	0	6	0	0
<i>Leptochloa dubia</i>	1	0	0	0	11	0	0
<i>Muhlenbergia arenacea</i>	7	19	19	0	16	0	0
<i>M. arenicola</i>	2	5	2	0	1	0	0
<i>M. asperifolia</i>	1	0	0	0	0	0	0
<i>M. pauciflora</i>	1	0	2	0	3	0	0
<i>M. repens</i>	3	0	0	0	0	0	0
<i>M. setifolia</i>	1	0	0	0	0	0	0
<i>P. hallii</i>	1	1	0	0	14	0	0
<i>Panicum obtusum</i>	3	0	1	0	2	0	1
<i>Scleropogon brevifolius</i>	14	14	12	0	0!	1	2
<i>Setaria leucopila</i>	2	9	2	0	10	0	2
<i>Sitanion hystrix</i>	1	0	0	0	2	0	1

Table 1. Extended.

Generalists ¹						Specialists ³
Gs	Ee	Ei	Mq	Sb	Xsp	
0	1	0	0	0	1	<i>Flexamia arizonensis</i> (39) (0.949)
2	33	1	0	0	0	<i>Athysanella rata</i> (19) (1.000)
2	3	0	0	0	1	<i>Flexamia prairiana</i> (26) (1.000)
1	0	0	0	0	0	<i>Laevicephalus vannus</i> (1) (1.000)
0	0	0	0	0	0	<i>Athysanella blockeri</i> (77) (0.922)
3	7	0	0	0	2	<i>Athysanella pastora</i> (49) (1.000)
0	0	0	0	0	0	<i>Athysanella ladella</i> (7) (0.286)
10	7	0	0	0	0	<i>Laevicephalus mexicanus</i> (11) (1.000)
1	30	0	0	0	0	<i>Laevicephalus opalinus</i> (6) (1.000)
0	5	0	0	0	0	<i>Laevicephalus minimus</i>
8	0	1	0	0	0	<i>Laevicephalus inconditus</i> (10) (0.900)
3	2	0	0	0	0	<i>Cazenius</i> sp. (2)
0	0	0	0	0	0	<i>Athysanella spatulata</i> (1) (1.000)
0	0	0	0	0	0	<i>Flexamia abbreviata</i> (55) (0.836)
0	4	0	0	0	0	<i>Flexamia flexulosa</i> (8) (1.000)
3	2	0	0	0	0	<i>Gillettiella labiata</i> (16) (1.000)
0	0	0	0	0	0	<i>Athysanella sinuata</i> (14) (1.000)
0	0	0	0	0	0	<i>Athysanella argenteola</i> (7) (0.778)
0	0	0	0	0	0	<i>Laevicephalus exiguus</i> (5) (1.000)
0	0	0	0	0	0	<i>Athysanella nigriventralis</i> (3) (1.000)
0	0	0	0	0	0	<i>Polyamia</i> sp. (2) (1.000)
0	0	0	0	0	0	<i>Flexamia curvata</i> (31) (1.000)
0	0	0	0	0	0	<i>Polyamia satur</i> (7) (1.000)
0	0	0	0	0	0	<i>Laevicephalus parvulus</i> (59) (1.000)
0	0	0	0	0	0	<i>Athysanella emarginata</i> (226) (0.991)
0	0	0	0	0	0	<i>Gillettiella atropunctata</i> (148) (0.943)
0	0	0	0	0	0	none
0	0	0	0	0	0	none
0	0	0	0	0	0	<i>Balclutha incisa</i> (1)
0	0	0	0	0	0	<i>Lonatura salsura</i> (40) (1.000)
0	0	0	0	0	0	<i>Memnonia</i> sp. (17) (1.000)
0	0	0	0	0	0	<i>Athysanella incerta</i> (279) (1.000)
0	0	0	0	0	0	<i>Memnonia</i> sp. (3)
0	0	0	0	0	0	<i>Athysanella triodana</i> (1) (1.000)
0	0	0	0	0	0	<i>Athysanella uncinata</i> (137) (1.000)
0	0	0	0	0	0	<i>Athysanella sagittata</i> (17) (1.000)
0	0	0	0	0	0	<i>Peconus scriptanus</i> (3) (1.000)
0	0	0	0	0	0	<i>Hecullus</i> sp. (22)
0	0	0	0	0	0	none
0	0	0	0	0	0	<i>Flexarida chaotica</i> (18) (1.000)
0	0	0	0	0	0	<i>Athysanella arcana</i> (491) (0.197)
0	0	0	0	0	0	none
0	0	0	0	0	0	<i>Flexamia inflata</i> (51) (1.000)
0	0	0	0	0	0	<i>Flexamia mescalero</i> (29) (1.000)
0	0	0	0	0	0	<i>Flexamia modica</i> (10) (1.000)
0	0	0	0	0	0	<i>Deltocephalus minutus</i> (25) (1.000)
0	0	0	0	0	0	<i>Telusius blandus</i> (2)
0	0	0	0	0	0	none
0	0	0	0	0	0	<i>Polyamia neoyavapai</i> (33) (0.818)
0	0	0	0	0	0	<i>Athysanella arcana</i> (491) (0.786)
0	0	0	0	0	0	<i>Decua curta</i> (35) (0.886)
0	0	0	0	0	0	none
0	0	0	0	0	0	none

Table 1. Continued.

Grass species	Generalists ¹						
	n ²	Au	Asp	Br	Bn	Ct	Dsp
<i>Sorghum halepense</i>	0	0	2	3	0	0	0
<i>Sporobolus airoides</i>	8	3	0	0	102	0	3
<i>Sporobolus cryptandrus</i>	5	7	6	0	42	0	3
<i>Sporobolus nealeyii</i>	10	43	14	0	63	0	5
<i>Sporobolus texanus</i>	2	0	0	0	7	1	11
<i>Sporobolus</i> sp.	2	4	0	0	44	2	18
<i>Stipa tenuissima</i>	1	0	0	0	0	0	4
<i>Trichachne californica</i>	1	1	0	0	5	0	0
<i>Tridens albescens</i>	2	5	2	0	22	0	81
<i>Tridens muticus</i>	1	0	0	4	1	0	0

¹ Symbols for generalists: Au: *Aceratagallia uhleri*; Asp: *Aceratagallia* spp. (not *uhleri*); Br: *Balclutha rosea*; Bn: *Balclutha neglecta*; Ct: *Circulifer tenellus*; Dsp: *Draculacephala* sp.; Gs: *Graminella sonora*; Ee: *Exitianus exitiosus*; Ei: *Endria inimica*; Mq: *Macrosteles quadrilineatus*; Sb: *Stirellus bicolor*; Xsp: *Xerophloea* spp. (*X. peltata* and *X. robusta*). The current status of taxonomy of *Aceratagallia* did not permit naming of species other than *A. uhleri*.

² n = number of collections in region.

³ Data for specialists is in the form: species [number of individuals] [oligophagy coefficient (Whitcomb et al. 1987, 1988) for given plant species]. Oligophagy coefficients were computed for species whose numbers in our overall surveys (Lynn and Whitcomb 1987) justified their assignment as specialists. Where insufficient data were available to classify a species as a generalist or specialist, no oligophagy coefficients were computed. In several cases, specialists are listed which occur in regions very close to the sampled region, but that did not occur in our samples. The present status of taxonomy of Hecalinae (*Dicyphonia*, *Hecullus*, *Hecalus*) did not permit assignment of species names.

1988, Whitcomb and Hicks 1994) and taxonomic idiosyncrasy (Hicks et al. 1992, Whitcomb and Hicks 1994) in the determination of biotic diversity.

We now briefly discuss certain host associations of the northern Chihuahuan grasslands that are of special interest:

The Laevicephalus-sideoats grama association. Southeastern New Mexico is a meeting place for four *Bouteloua* leafhopper specialists of the genus *Laevicephalus*. All are members of the "minima" clade of Ross and Hamilton (1972). *Laevicephalus inconditus* Knull is largely Chihuahuan in distribution, and occurs exclusively on side-

oats grama (*Bouteloua curtipendula*) at low elevation. *Laevicephalus opalinus* Ross and Hamilton also occurs on side-oats grama in low to medium altitude grasslands; to the west of this region, this species occurs on blue grama also (Hicks and Whitcomb 1992). *Laevicephalus minimus* (Osborn and Ball) occurs on blue grama at higher elevations in the Sacramento Mountains and Colorado Rockies, but is largely a prairie species, where it specializes on sideoats grama east to Maryland (Hicks and Whitcomb 1992). Finally, *L. mexicanus* (Ross and Hamilton), known before our studies only from Mexico, was collected once at

Table 1. Extended. Continued.

Generalists ¹						Specialists ³
Gs	Ee	Ei	Mq	Sb	Xsp	
0	0	0	1	1	0	none
0	4	0	0	0	1	<i>Unoka ornata</i> (39) (0.231)
						<i>Athysanella truncata</i> (78) (1.000)
						<i>Athysanella callida</i>
						<i>Athysanella kanabana</i> (17) (1.000)
						<i>Athysanella blanda</i> (8) (1.000)
						<i>Dicyphonia</i> sp. (6)
						<i>Hecullus</i> sp. (51)
1	22	2	0	0	4	<i>Dicyphonia</i> sp. (1)
						<i>Hecullus</i> sp. (1)
						<i>Athysanella curtipennis</i> (15) (1.000)
						<i>Unoka ornata</i> (39) (0.077)
0	1	0	0	0	0	<i>Athysanella stylosa</i> (118) (1.000)
						<i>Athysanella ladella</i> (5) (0.714)
						<i>Unoka ornata</i> (39) (0.077)
0	1	0	0	0	0	<i>Balclutha incisa</i> (3)
0	2	2	0	1	1	<i>Dicyphonia</i> sp. (2)
						<i>Athysanella curtipennis</i> (15) (1.000)
0	0	1	0	0	0	<i>Dikraneura</i> sp. (19)
0	3	0	0	0	0	none
1	1	0	0	0	0	none
0	0	0	0	0	0	none

Roswell. The uneven distribution of these species in northern Chihuahuan grasslands suggests that all may be at the edge of their ranges, where they may be extirpated in years when climate may be unfavorable. *Laevicephalus mexicanus* may be only one of many leafhopper species that are common south of the border, but that persist at more northerly latitudes in the absence of killing freezes.

Flexamia species. Although the genus *Flexamia* is primarily adapted to prairie or mesic grasslands, eight species occur in northern Chihuahuan grasslands, where each specializes on a specific host. Several of these hosts are *Muhlenbergia* species. For example, *Flexamia mescalero* Whitcomb and Hicks was found at only a single location on *Muhlenbergia pauciflora* growing on a moist slope. Although *F. mescalero* may occur in Mexico, extensive collecting in other locations on its apparent host in the United States has revealed no further populations. Because its host is rel-

atively limited in distribution and abundance, *F. mescalero* should be tentatively considered to be threatened, and its habitat protected. A second seldom-collected Chihuahuan species, *F. zacate*, occurs on its host, *Muhlenbergia porteri*, in Otero County, New Mexico, and El Paso County, Texas. Otherwise, this species is known only from Big Bend National Park, in trans-Pecos Texas. Another infrequently collected species, *F. modica* (Beamer and Tuthill), is a specialist of *Muhlenbergia repens* at elevations above about 5400 ft throughout much of southern New Mexico. In saline wetlands, *Flexamia inflata* occurs on *Muhlenbergia asperifolia*.

Although two specialists of blue grama, *F. abbreviata* (Osborn and Ball) and *F. flexulosa* (Ball) occur in the region, one (*F. flexulosa*) is understood best in terms of the differential phylogenetic origin of the two species (Whitcomb and Hicks 1994). *Flexomia flexulosa* diverged from a clade (Whitcomb and Hicks 1988) that probably

originated in northern grasslands. On the other hand, *F. abbreviata* reached the blue grama grasslands of New Mexico by a diametrically opposite route: i.e. through the mixed *Bouteloua* grasslands of the Chihuahuan Desert. It is not surprising, therefore, that in this area, as in Chihuahuan grasslands to the south, blue grama is colonized almost exclusively by *F. abbreviata*. This relationship is confirmed by the reciprocal observation that the blue grama grasslands of the Colorado Plateau are colonized almost exclusively by *F. flexulosa*.

Athysanella species. Most *Athysanella* species in this region, including the endemics, occupied their usual host. Two relationships in the region, those of *Athysanella* (*Diphypyga*) *triodana* Ball and Beamer with *Dasyochloa pulchella*, and of *A. (Pedumella)* *spatulata* Ball and Beamer with black grama, *Bouteloua eriopoda* may be very old. These leafhopper species were placed in primitive clades by Blocker and Johnson (1988a). It is possible that these relationships may date to early or even pre-Pleistocene times when the host grasses, both able to colonize bare rocky slopes, may have been more common than they are today.

A collection from galleta (*Hilaria jamesii*) in the northernmost portion of the Chihuahuan grasslands represents the sole record of *Athysanella* (*Gladionura*) *uncinata* Ball and Beamer on this host. The usual host for *A. uncinata* is a close congener of tobosa (*Hilaria mutica*). Because these grass species are almost completely allopatric in New Mexico (K. Allred, personal communication), the factors governing host relationships could have been confounded. We believe this collection demonstrates that *A. uncinata* is able to feed on galleta in a climatic regime compatible with the life history strategy of the leafhopper specialist. Indeed, experimental data (Whitcomb et al. 1986) have shown that most leafhopper species tested, including some apparently strict specialists, had much broader experimental host ranges than field observations

had suggested. We therefore believe that the four specialists of *Hilaria mutica* and the six specialists of galleta (see Table 1) are most likely confined to their ranges by adaptations to the idiosyncrasies of local climate, rather than by nutritional or other association with the closely related *Hilaria* species.

Burrograss. We noted three striking features of the assemblage of leafhoppers on burrograss (*Scleropogon brevifolius*). One is the only example [*Decua curta* (Beamer)] from our grassland studies that suggest host specificity exists in the xylem-feeding subfamily Cicadellinae. The second is the extremely high numerical abundance of the specialist *Athysanella* (*G.*) *arcana* Ball and Beamer. This species was the most abundant of all specialists we encountered in the region. Collection data suggesting that it may also occur on *Muhlenbergia arenacea* may be misleading, since burrograss almost universally occurs with *M. arenacea* in saline/alkaline flats. The third unusual feature that emerged (Table 1) is the complete absence of the commonest and most widespread supertramp of the region, *Balclutha neglecta* (Delong and Davidson), from 14 collections on burrograss.

Diversity. Because we have elucidated (Whitcomb et al. 1986, 1987, 1988, Whitcomb and Hicks 1994) the brickwork of North American grass-leafhopper host relations, a reasonable interpretation of leafhopper diversity in the grasslands of southeastern New Mexico can be constructed. Cicadellid diversity is seen to be a direct consequence of the regional distribution of dominant, perennial grass hosts. Presumably, forb diversity makes a similar contribution in its provision for ovipositional and food hosts for forb generalists and specialists.

Comparison of specializations within the region studied reveals no case of a specialization that is different within the region than in an adjacent region. In the northern Chihuahuan grasslands, as in other regions, however, species at the limit of their ranges

may be more restrictive specialists than in portions of their range where they are more abundant. This is especially true of southern species at the northern limits of their ranges (Whitcomb et al. 1987).

Leafhopper host specificities identified in this study are in excellent agreement with generalizations for insect host specialists (Strong 1979), and leafhopper grass specialists in particular (Whitcomb et al. 1987), that the number of specialists associated with a given host is a function of its dominance over evolutionary and (especially) contemporary time. Thus, dominant hosts such as buffalograss, blue grama, side-oats grama, saltgrass, tobosa and alkali sacaton have large specialist assemblages. Less common grasses such as burrograss and *Dasyochloa pulchella* have smaller assemblages of associated specialists, and even less common grasses such as *Leptochloa* or *Tridens* species appear to have no associated specialists. In this context, the species richness of *Athysanella* species associated with two gypsophilic grasses, gyp grama (*Bouteloua breviseta*) and gyp dropseed (*Sporobolus nealleyii*), is rather remarkable. Both grasses are reasonably common in gyp areas of New Mexico, but the total global biomass of these grass species is low, especially when compared with abundant New Mexico grasses such as blue grama or side-oats grama. Regional, rather than global abundance is therefore sufficient to promote speciation. Three *Athysanella* species are associated with gyp grama. These are *A. pastora*, *A. blockeri* n. sp. (described herein) and *A. ladella*. The latter species, collected only in gyp, saline or alkaline habitats, may be shared with gyp dropseed and/or other grasses that tolerate the harsh edaphic conditions of desert lowlands. Gyp dropseed also harbors an apparent specialist, *A. stylosa*. The current regional biomass of gyp dropseed is substantially less than that of gyp grama. One leafhopper species (*Unoka ornata* Osborn), although clearly a specialist on *Sporobolus* species, is found in northern Chihuahuan grasslands not only

on gyp dropseed, a grass with very low (often about 10–12 cm) growth form and very patchy local occurrence, but also on a larger *Sporobolus* species (sand dropseed, *Sporobolus cryptandrus*). It also occurs on the much larger alkali sacaton (*Sporobolus airoides*), which can reach 3 m in height, and which often occurs in dense stands. The latter grass, a common inhabitant of wet alkaline and/or saline bottoms throughout southwestern deserts, has a very rich leafhopper fauna of its own.

Insects and gyp regions. We have discussed herein the leafhopper fauna of a small fraction of the gyp formations of the American Southwest and Mexico. The recent discovery of three new species of leafhoppers (*A. blockeri*, *A. pastora*, and *A. stylosa*) in this single small region suggests that other new and interesting species doubtlessly remain to be discovered.

For gypsophilous species, the gypsum outcroppings represent true “islands,” isolated edaphically as well as spatially from other suitable habitat. This insularity has resulted in considerable speciation among plant gypsophiles. The brachyptery of *Athysanella* species suggests that their evolution may be affected equally profoundly. Certainly the presence of two species of subgenus *Athysanella* on gyp grama in New Mexico suggests a complex geologic history, in which isolated populations have speciated rapidly. In this regard, the majority of *Athysanella* species are severely restricted in their geographic distribution.

Conservation significance. Clearly, the gyp, saline, and/or alkaline bottomlands of the Southwest have promoted a rich diversification of leafhoppers and, undoubtedly, other insect specialists as well. Of these formations, the gyp areas (Johnson 1941, Powell and Turner 1977, Waterfall 1946) are one of the least common and one of the richest (per unit area) in terms of endemic species. The biotic content of the areas has not been well studied, and even new plant species continue to be identified from them.

At a time when conservation biology is

turning increasingly to consideration of entire functioning ecosystems, there is a danger that requirements for conservation of species from small, edaphically unusual habitats could be overshadowed by broader plans to protect large and aesthetically attractive biotic regions.

In the case of the gyp regions of southeastern New Mexico, entire functioning ecosystems may consist of relatively small areas in lowlands that can be expected to experience increasing pressures for development. It is our belief that state Heritage programs, particularly if they are associated with initiatives to acquire and protect endangered habitats associated with unusual edaphic conditions, should scrutinize gyp areas closely to be certain that small but biotically rich habitats and ecosystems, with their associated endemic species, are not inadvertently destroyed.

Athysanella (Athysanella) blockeri

Hicks and Whitcomb,

NEW SPECIES

Length of male 2.30 to 2.76 mm, female 3.32 to 3.96 mm; head width of male 0.95 to 1.07 mm, female 1.01 to 1.21 mm; pronotal width of male 0.87 to 0.97 mm; female 0.93 to 1.07 mm; interocular width of male 0.40 to 0.46 mm, female 0.46 to 0.57 mm; vertex length of male 0.36 to 0.44 mm, female 0.42 to 0.54 mm; pronotal length of male 0.32 to 0.38 mm, female 0.34 to 0.42 mm.

Character code: 1-1-1-1-2-1-1-0-2-0-1-0-1-0-1-1-0-0 (see Blocker and Johnson 1988).

Color tawny; vertex with fuscous spots on margin of vertex, one apical and one on each side between the apex and the eyes. Vertex, face, pronotum, abdomen, and venter with irregular brown markings. Forewings and legs often with dark brown spots.

Forewings brachypterous (Fig. 2), exposing 4.0–4.5 pregenital abdominal terga; ocellus approximately 1.0 its diameter from eye. Hind tibial spur often absent (Fig. 3G);

when present (Fig. 3F), more than $\frac{3}{4}$ the length of the first tarsomere.

Male.—Pygofer (Fig. 3C) with caudal margin extended, with numerous macrosetae, not embrowned; anal tube attaining apex of pygofer; valve rounded on apical margin; plates truncate, separated basally, with a small sclerotized section on the outer caudal margin attaining $\frac{2}{3}$ length of pygofer. Styles (Fig. 3A) rectangular in broad aspect, with short lobe on lateral margin, equalling the apices of plates. Connective about $\frac{1}{4}$ to $\frac{1}{5}$ longer than style; aedeagus (Fig. 3B) elongate with parallel-sided shaft slightly recurved, caudal margin of shaft smooth, with dorsal apodeme short, undeveloped. Aedeagus with basal process that becomes bifurcate, in caudal aspect, at about $\frac{1}{3}$ length. The bifid process parallels the shaft, bending, in lateral view, antero-dorsad toward the aedeagus with paired apical halves situated on each side of aedeagal shaft and the upper $\frac{1}{3}$ irregularly serrate.

Female.—Sternum VII (Fig. 3E) with caudal margin produced, medial lobe slightly concave, somewhat embrowned.

Types.—*Holotype male*: NEW MEXICO: Carlsbad, 3800 ft, 9 Aug. 1984, R. F. Whitcomb, IPL 000841, deposited in the National Museum of Natural History (NMNH), Washington D. C. *Paratypes*: 29 males, 23 females, same collection data, IPL 000841 and 843; and NEW MEXICO: Whites City, 3800 ft, 27 Aug. 1985, A. L. Hicks and R. F. Whitcomb, IPL 002102 and 2103, are in NMNH; California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa, Ontario; University of Kansas, Snow Museum, Lawrence; and Ohio State University, Columbus.

Athysanella (Athysanella) blockeri is related to *A. robusta*, to which it will key (Blocker and Johnson 1988) but can be separated from it and all other *Athysanella* species by its unique basal aedeagal process. In *robusta*, this process is not bifid apically, and does not bend toward the aedeagal shaft. Also, the pygofer of *A. blockeri* is not as produced as in *robusta*. We have not ob-

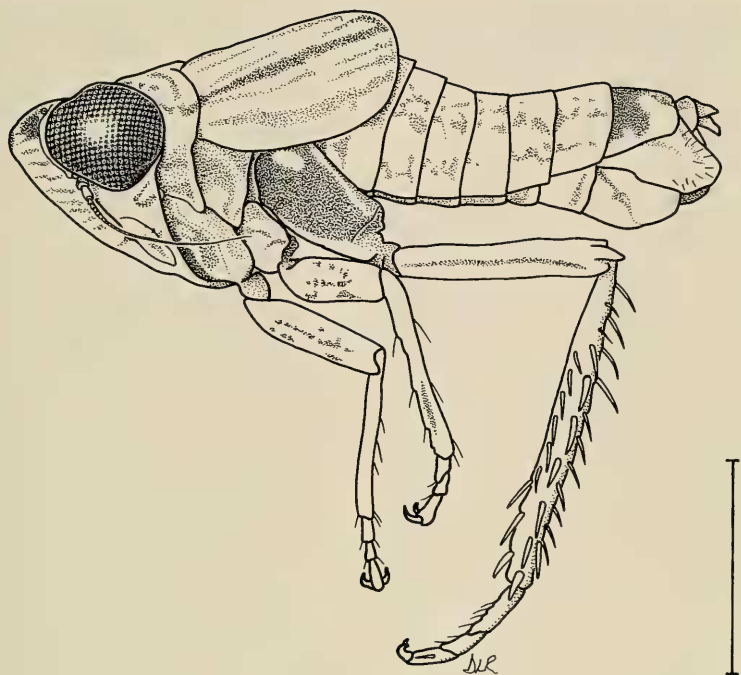


Fig. 2. *Athysanella blockeri*, habitus.

served undeveloped or parasitized individuals, or long-winged forms.

It is important to note that the hind tibial spur is missing or greatly reduced in many specimens of *A. blockeri*. Such a specimen

would incorrectly key to subgenus *Amphipyga* (Blocker and Johnson 1990). However, because this species has been collected only in gyp localities in southeastern New Mexico, and is quite distinct, aberrant specimens

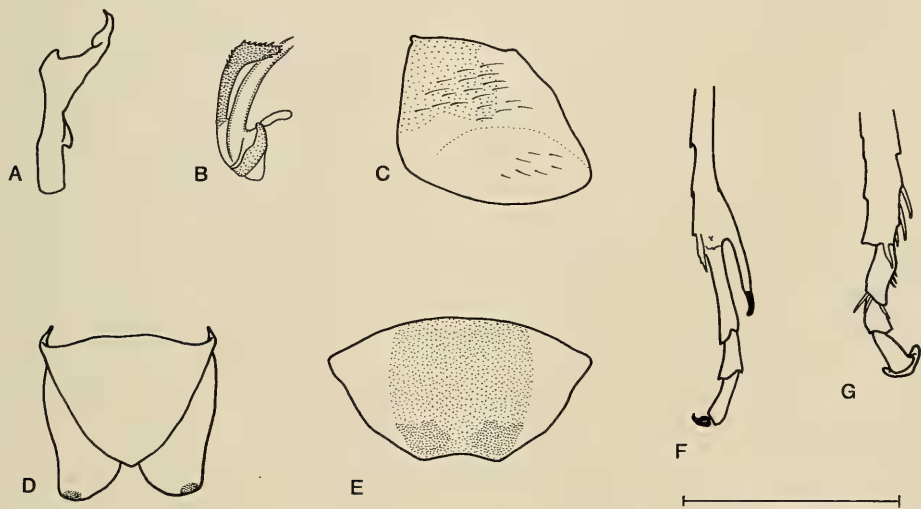


Fig. 3. *Athysanella blockeri*. A, Style, ventral aspect. B, Aedeagus, lateral aspect. C, Male pygofer, lateral aspect. D, Male plates and valve, ventral aspect. E, Female sternum VII, ventral aspect. F, Hind tarsi and tibial spur. G, Hind tarsi; tibial spur missing.

should be easily recognizable. The only known host is gyp grama, *Bouteloua brevisetia* Vasey.

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APPENDIX

Scientific and common names of grass species studied.

Aristida spp., three awn grasses; *Bouteloua breviseta* Vasey, gyp grama; *Bouteloua curtipendula* (Michx.) Torr., side-oats grama; *Bouteloua eriopoda* (Torr.) Torr., black grama; *Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths, blue grama; *Bouteloua hirsuta* Lag., hairy grama; *Buchloë dactyloides* (Nutt.) Engelm.; buffalograss; bermudagrass; *Chloris cucullata* Bisch., hooded windmillgrass; *Chloris verticillata* Nutt., windmillgrass; *Cynodon dactylon* (L.) Pers.; *Distichlis stricta* (L.) Greene, salt grass; *Erioneuron pilosum* Buckl. Nash, hairy tridens; *Dasyochloa pulchella* (Kunth) Rydb. (= *Erioneuron pulchellum*), fluffgrass; *Hilaria jamesii* (Torr.) Benth., galleta; *Hilaria mutica* (Buckl.) Benth., tobosa; *Leptochloa dubia* (Kunth) Nees, green

sprangletop; *Muhlenbergia arenacea* (Buckl.) Hitchc., ear muhly; *Muhlenbergia arenicola* Buckl., sand muhly; *Muhlenbergia asperifolia* (Nees. Mey.) Parodi, scratchgrass; *Muhlenbergia pauciflora* Buckl., New Mexico muhly; *Muhlenbergia porteri* Scribn. ex Beal, bush muhly; *Muhlenbergia repens* (Presl) Hitchc., creeping muhly; *Muhlenbergia setifolia* Vasey, curly leaf muhly; *Panicum hallii* Vasey, Hall's panicum; *Panicum obtusum* Kunth, vine mesquite; *Scleropogon brevifolius* Phil., burrograss; *Setaria leucopila* (Scribn. & Merr.) K. Schum., plains bristletail; *Sitanion hystrix* (Nutt.) Sm., squirreltail; *Sorghum halepense* (L.) Pers., johnsongrass; *Sporobolus airoides* (Torr.) Torr., alkali sacaton; *Sporobolus cryptandrus* (Torr.) Gray, sand dropseed; *Sporobolus nealleyi*, Vasey, gyp dropseed; *Sporobolus texanus* Vasey, Texas dropseed; *Stipa tenuissima* Trin., finestem needlegrass; *Trichachne californica* (Benth.) Chase, cottontop; *Tridens albens* (Vasey) Woot. & Standl., white tridens; *Tridens muticus* (Torr.) Nash, slim tridens.